



TFT LCD Approval Specification

MODEL NO.: N156O6-L02

Customer : Dell

Approved by : _____

Note :

記錄	工作	審核	角色	投票
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11. DEFINITION OF LABELS

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11.1 CMO MODULE LABEL

11.2 DELL 2D MODULE LABEL

11.3 CARTON LABEL

11.4 DELL CARTON LABEL

**REVISION HISTORY**

Version	Date	Page (New)	Section	Description
Ver 3.0	Mar.04, 2009	All	All	Approval specification first issued.



1. GENERAL DESCRIPTION

1.1 OVERVIEW

N156O6-L02 is a 15.6" (15.547" diagonal) TFT Liquid Crystal Display module with LED Backlight unit and 40 pins LVDS interface. This module supports 1600 x 900 WXGA+ mode and can display 262,144 colors. The optimum viewing angle is at 6 o'clock direction. The converter module for backlight is built in.

1.2 FEATURES

- WXGA+ (1600x900 pixels) resolution.
- VESA standard LED model.
- 3.3V LVDS (Low Voltage Differential Signaling) interface with 2 pixel/clock
- RoHS compliance

1.3 APPLICATION

- TFT LCD Notebook

1.4 GENERAL SPECIFICATIONS

Item	Specification	Unit	Note
Active Area	344.16 (H) x 193.59 (V) (15.547" diagonal)	mm	(1)
Bezel Opening Area	348.76(H)x197.19(V)	mm	
Driver Element	a-si TFT active matrix	-	-
Pixel Number	1600 x R.G.B. x 900	pixel	-
Pixel Pitch	0.215 (H) x 0.215 (V)	mm	-
Pixel Arrangement	RGB vertical stripe	-	-
Display Colors	262,144	color	-
Transmissive Mode	Normally white	-	-
Surface Treatment	Hard coating (3H), Glare	-	-

1.5 MECHANICAL SPECIFICATIONS

Item		Min.	Typ.	Max.	Unit	Note
Module Size	Horizontal(H)	358.8	359.3	359.8	mm	(1)
	Vertical(V)	209	209.5	210	mm	
	Thickness(T)		5.2	5.5	mm	
Weight			440	455	g	

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.

2. ABSOLUTE MAXIMUM RATINGS

2.1 ABSOLUTE RATINGS OF ENVIRONMENT

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Storage Temperature	T _{ST}	-20	+60	°C	(1)
Operating Ambient Temperature	T _{OP}	0	+50	°C	(1), (2)
Shock (Non-Operating)	S _{NOP}	-	220/2	G/ms	(3), (5)
Vibration (Non-Operating)	V _{NOP}	-	1.5	G	(4), (5)

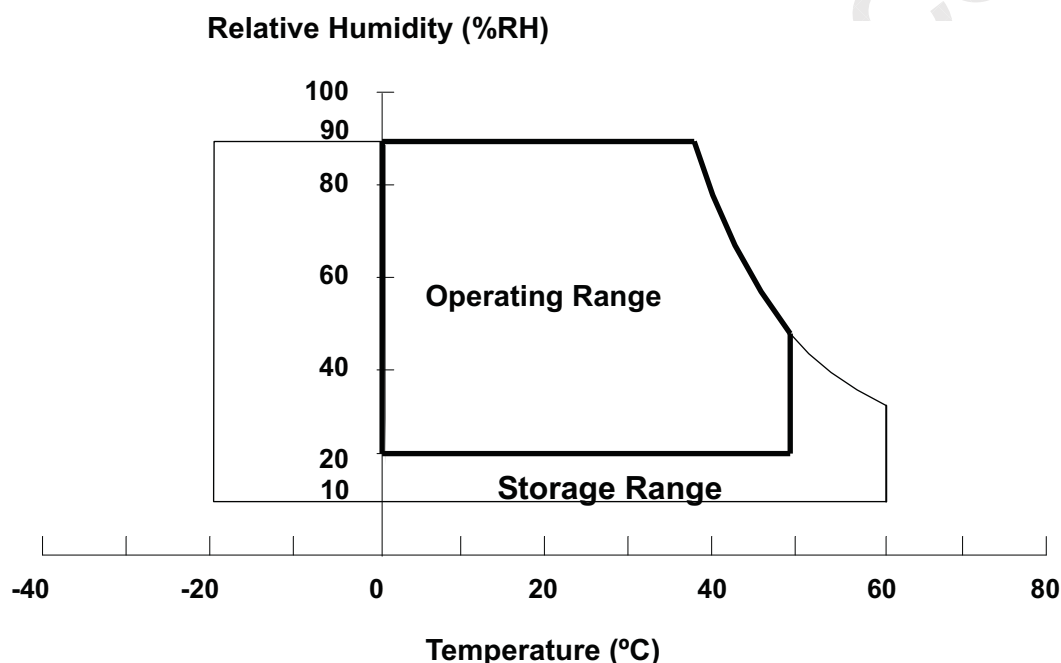
Note (1) Temperature and relative humidity range is shown in the figure below.

(a) 90 %RH Max. (Ta ≤ 40 °C).

(b) Wet-bulb temperature should be 39 °C Max. (Ta > 40 °C).

(c) No condensation.

Note (2) The temperature of panel surface area should be 0 °C min. and 60 °C max.



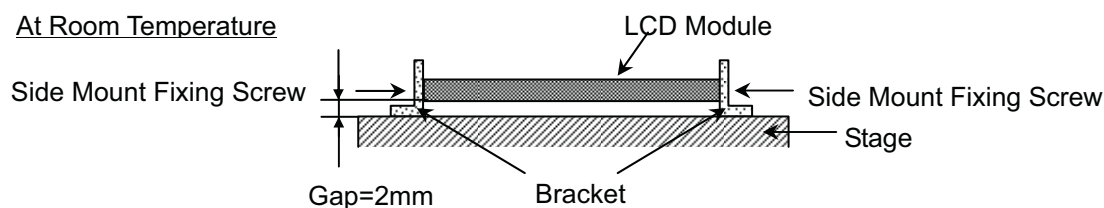
Note (3) 1 time for $\pm X$, $\pm Y$, $\pm Z$. for Condition (220G / 2ms) is half Sine Wave,.

Note (4) 10~500 Hz, 30 min/cycle, 1cycle for X,Y,Z-axis.

Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.

The fixing condition is shown as below:

At Room Temperature





2.2 ELECTRICAL ABSOLUTE RATINGS

2.2.1 TFT LCD MODULE

Item	Symbol	Value		Unit	Note
		Min.	Max.		
Power Supply Voltage	V _{CC}	-0.3	+4.0	V	(1)
Logic Input Voltage	V _{IN}	-0.3	V _{CC} +0.3	V	

2.2.2 BACKLIGHT UNIT

Item	Value		Unit	Note
	Min	Max.		
LED Light Bar Power Supply Voltage	-50	34	V _{DC}	(1), (2)
LED Light Bar Power Supply Current	0	150	mA _{DC}	

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for LED (Refer to Section 3.2 for further information).


CHI MEI
OPTOELECTRONICS CORP.

Issued Date: Mar. 04, 2009

Model No.: N156O6-L02

Approval

3. ELECTRICAL CHARACTERISTICS

3.1 TFT LCD MODULE

Ta = 25 ± 2 °C

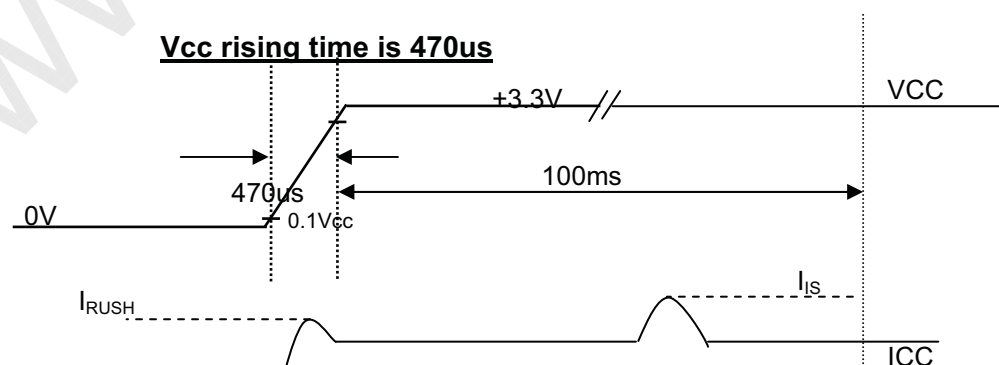
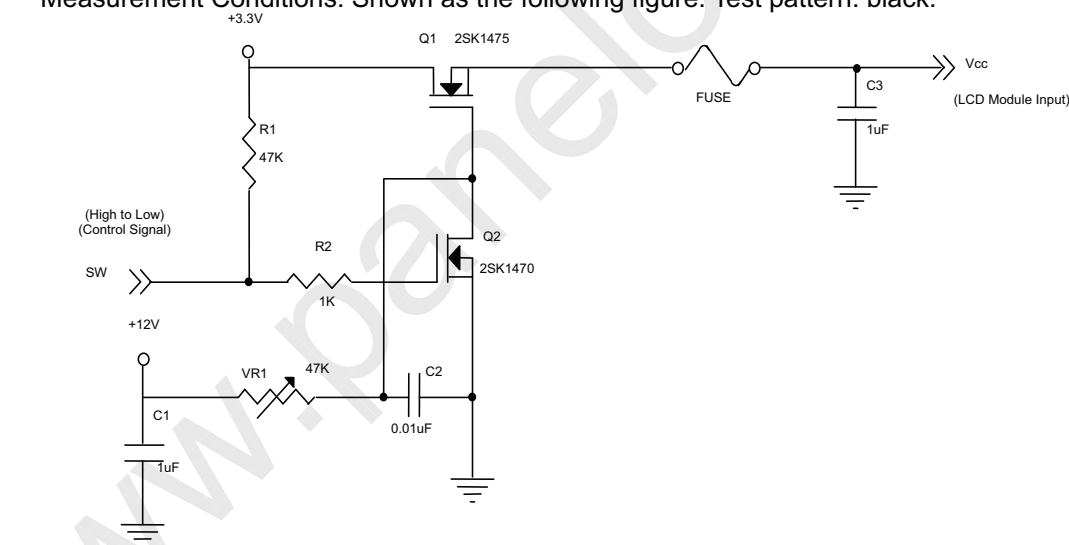
Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Power Supply Voltage		V _{CC}	3.0	3.3	3.6	V	-
Ripple Voltage		V _{RP}	-	-		mV	-
Rush Current		I _{RUSH}	-	-	1.5	A	(2)
Initial Stage Current		I _{IS}	-	-	1.0	A	(2)
Power Supply Current	White	I _{CC}	235	255	275	mA	(3)a
	Black		320	355	410	mA	(3)b
LVDS Differential Input High Threshold		V _{TH(LVDS)}	-	-	+100	mV	(5), V _{CM} =1.2V
LVDS Differential Input Low Threshold		V _{TL(LVDS)}	-100	-	-	mV	(5) V _{CM} =1.2V
LVDS Common Mode Voltage		V _{CM}	1.125	-	1.375	V	(5)
LVDS Differential Input Voltage		V _{ID}	100	-	600	mV	(5)
Terminating Resistor		R _T	-	100	-	Ohm	-
Power per EBL WG		P _{EBL}	-	2.2	-	W	(4)

Note (1) The ambient temperature is Ta = 25 ± 2 °C.

Note (2) I_{RUSH}: the maximum current when VCC is rising

I_{IS}: the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.



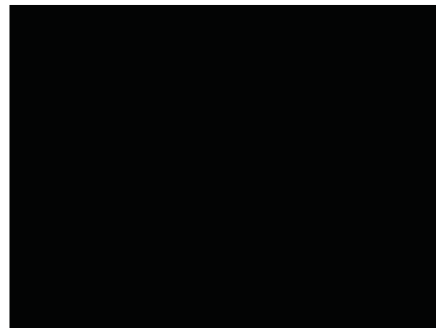
Note (3) The specified power supply current is under the conditions at $V_{CC} = 3.3\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, DC Current and $f_v = 60\text{ Hz}$, whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern

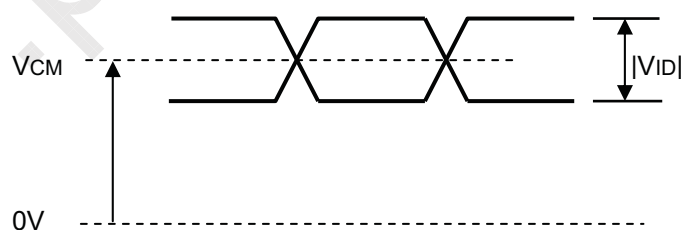
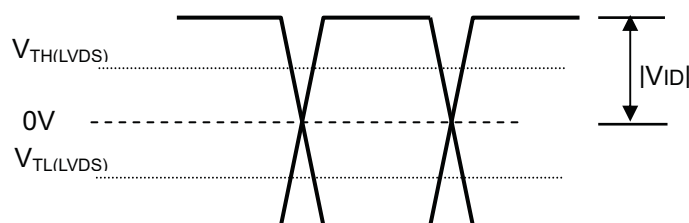


Active Area

Note (4) The specified power are the sum of LCD panel electronics input power and the converter input power. Test conditions are as follows.

- (a) $V_{CC} = 3.3\text{ V}$, $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$, $f_v = 60\text{ Hz}$,
- (b) The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.
- (c) Luminance: 60 nits.

Note (5) The parameters of LVDS signals are defined as the following figures.

Single Ended**Differential**

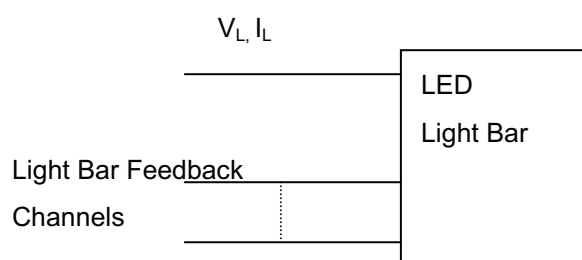


3.2 BACKLIGHT UNIT

 $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$

Parameter	Symbol	Value			Unit	Note
		Min.	Typ.	Max.		
LED light bar input voltage	V_L	29	32	34	V_{DC}	(1), (2)
LED light bar input current	I_L	114	120	126	mA_{DC}	
Power Consumption	P_L	3.306	3.84	4.284	W	(3), $I_L = 120\text{ mA}$ Duty=100%
LED Life Time	L_{BL}	15000	-	-	Hrs	(4)

Note (1) LED light bar configuration is shown as below.



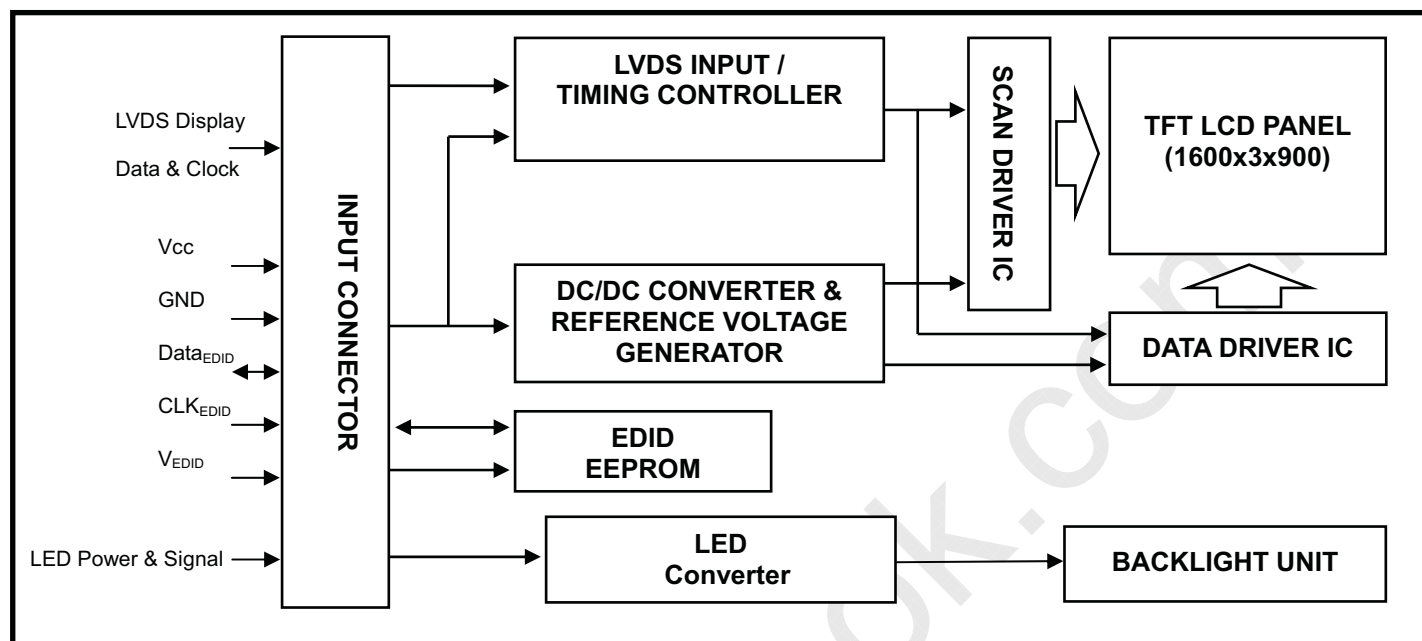
Note (2) For better LED light bar driving quality, it is recommended to utilize the adaptive boost converter with current balancing function to drive LED light-bar.

Note (3) $P_L = I_L \times V_L$

Note (4) The lifetime of LED is defined as the time when it continues to operate under the conditions at $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ and $I_L = 20.0\text{ mA}$ (Per EA) until the brightness becomes $\leq 50\%$ of its original value.

4. BLOCK DIAGRAM

4.1 TFT LCD MODULE



5. INPUT TERMINAL PIN ASSIGNMENT--EE

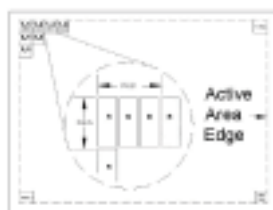
5.1 TFT LCD MODULE

Pin	Symbol	Description	Polarity	Remark
1	DIAG_LOOP	Diag pin.		
2	AVDD	Power Supply, 3.3V (typical)		
3	AVDD	Power Supply, 3.3V (typical)		
4	DVDD	DDC 3.3V power		
5	TEST	Panel Self Test		
6	SCL	DDC Clock		
7	SDA	DDC Data		
8	RXO0-	LVDS Differential Data Input (Odd)	Negative	
9	RXO0+	LVDS Differential Data Input (Odd)	Positive	
10	Vss	Ground		
11	RXO1-	LVDS Differential Data Input (Odd)	Negative	
12	RXO1+	LVDS Differential Data Input (Odd)	Positive	
13	Vss	Ground		
14	RXO2-	LVDS Differential Data Input (Odd)	Negative	
15	RXO2+	LVDS Differential Data Input (Odd)	Positive	
16	Vss	Ground		
17	RXOC-	LVDS Clock Data Input (Odd)	Negative	
18	RXOC+	LVDS Clock Data Input (Odd)	Positive	
19	Vss	Ground		
20	RxE0-	LVDS Differential Data Input (Even)	Negative	
21	RxE0+	LVDS Differential Data Input (Even)	Positive	
22	Vss	Ground		
23	RxE1-	LVDS Differential Data Input (Even)	Negative	
24	RxE1+	LVDS Differential Data Input (Even)	Positive	
25	Vss	Ground		
26	RxE2-	LVDS Differential Data Input (Even)	Negative	
27	RxE2+	LVDS Differential Data Input (Even)	Positive	
28	Vss	Ground		
29	RXEC-	LVDS Clock Data Input (Even)	Negative	
30	RXEC+	LVDS Clock Data Input (Even)	Positive	
31	LED_GND	LED Ground		
32	LED_GND	LED Ground		
33	LED_GND	LED Ground		
34	DIAG_LOOP	Diag pin.		
35	LED_PWM	PWM Control Signal of LED Converter		
36	LED_EN	Enable Control Signal of LED Converter		
37	NC	No Connection		
38	LED_VCCS	LED Power		
39	LED_VCCS	LED Power		
40	LED_VCCS	LED Power		

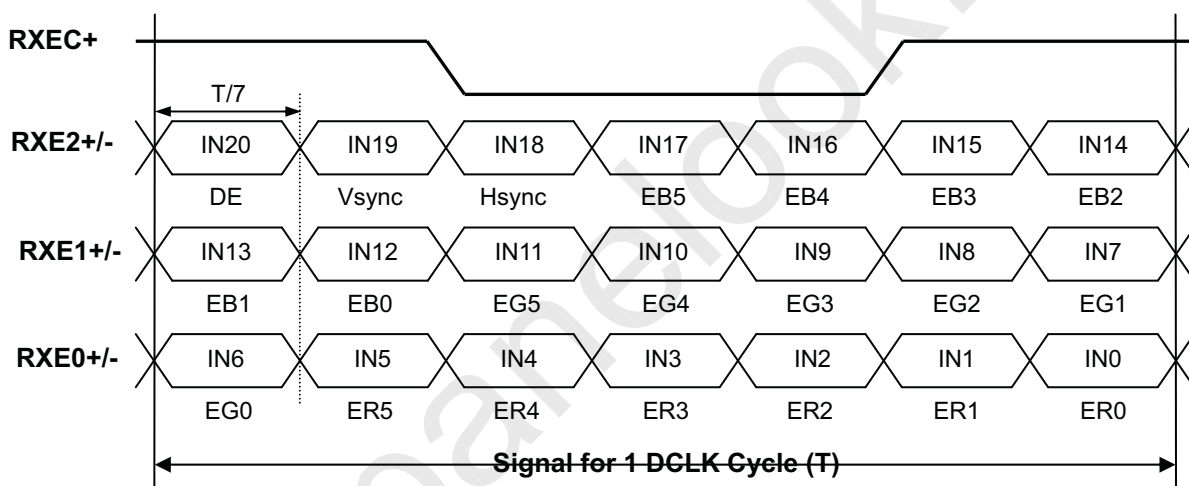
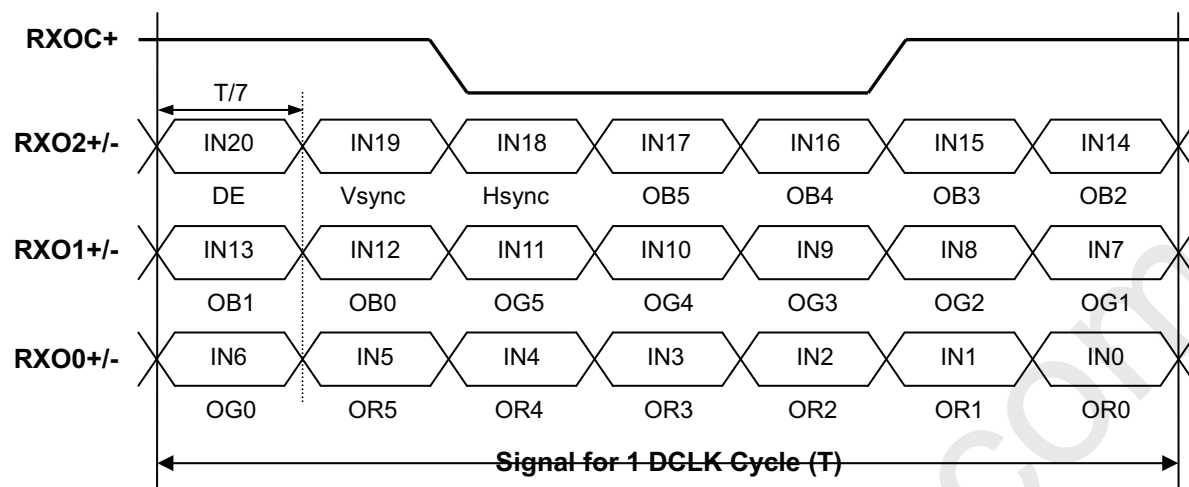
Note (1) Connector Part No.: I-PEX 20455-040E-12 or equivalent

Note (2) User's connector Part No: I-PEX 20453-040T-01 or equivalent

Note (3) The first pixel is odd as shown in the following figure.



5.2 TIMING DIAGRAM OF LVDS INPUT SIGNAL



5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

Color		Data Signal																	
		Red						Green						Blue					
		R5	R4	R3	R2	R1	R0	G5	G4	G3	G2	G1	G0	B5	B4	B3	B2	B1	B0
Basic Colors	Black	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0
	Green	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0
	Blue	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1
	Cyan	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1
	Magenta	1	1	1	1	1	1	0	0	0	0	0	0	1	1	1	1	1	1
	Yellow	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
	White	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Gray Scale Of Red	Red(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Red(1)	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(2)	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
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	Red(61)	1	1	1	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Red(62)	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Red(63)	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	
Gray Scale Of Green	Green(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Green(1)	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
	Green(2)	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
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	Green(61)	0	0	0	0	0	0	1	1	1	1	0	1	0	0	0	0	0	0
	Green(62)	0	0	0	0	0	0	1	1	1	1	1	0	0	0	0	0	0	0
Green(63)	0	0	0	0	0	0	1	1	1	1	1	1	0	0	0	0	0	0	
Gray Scale Of Blue	Blue(0)/Dark	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Blue(1)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
	Blue(2)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0
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	Blue(61)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	0	1
	Blue(62)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	0
Blue(63)	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	

Note (1) 0: Low Level Voltage, 1: High Level Voltage

5.4 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPD1 standards.

Byte # (decimal)	Byte # (hex)	Field Name and Comments	Value(hex)	Value(binary)
0	0	Header	00	00000000
1	1	Header	FF	11111111
2	2	Header	FF	11111111
3	3	Header	FF	11111111
4	4	Header	FF	11111111
5	5	Header	FF	11111111
6	6	Header	FF	11111111
7	7	Header	00	00000000
8	8	EISA ID manufacturer name ("CMO")	0D	00001101
9	9	EISA ID manufacturer name (Compressed ASCII)	AF	10101111
10	0A	ID product code (N156O6-L02)	77	01110111
11	0B	ID product code (hex LSB first; N156O6-L02)	15	00010101
12	0C	ID S/N (fixed "0")	00	00000000
13	0D	ID S/N (fixed "0")	00	00000000
14	0E	ID S/N (fixed "0")	00	00000000
15	0F	ID S/N (fixed "0")	00	00000000
16	10	Week of manufacture (fixed week code)	28	00101000
17	11	Year of manufacture (fixed year code)	12	00010010
18	12	EDID structure version # ("1")	01	00000001
19	13	EDID revision # ("3")	03	00000011
20	14	Video I/P definition ("digital")	90	10010000
21	15	Active area horizontal 34.416cm	22	00100010
22	16	Active area vertical 19.359cm	13	00010011
23	17	Display Gamma (Gamma = "2.2")	78	01111000
24	18	Feature support ("Active off, RGB Color")	0A	00001010
25	19	Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0	9E	10011110
26	1A	Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0	D5	11010101
27	1B	Rx=0.623	9F	10011111
28	1C	Ry=0.341	57	01010111
29	1D	Gx=0.315	50	01010000
30	1E	Gy=0.60	99	10011001
31	1F	Bx=0.159	28	00101000
32	20	By=0.087	16	00010110
33	21	Wx=0.313	50	01010000
34	22	Wy=0.329	54	01010100
35	23	Established timings 1	00	00000000
36	24	Established timings 2	00	00000000
37	25	Manufacturer's reserved timings	00	00000000
38	26	Standard timing ID # 1	01	00000001
39	27	Standard timing ID # 1	01	00000001



40	28	Standard timing ID # 2	01	00000001
41	29	Standard timing ID # 2	01	00000001
42	2A	Standard timing ID # 3	01	00000001
43	2B	Standard timing ID # 3	01	00000001
44	2C	Standard timing ID # 4	01	00000001
45	2D	Standard timing ID # 4	01	00000001
46	2E	Standard timing ID # 5	01	00000001
47	2F	Standard timing ID # 5	01	00000001
48	30	Standard timing ID # 6	01	00000001
49	31	Standard timing ID # 6	01	00000001
50	32	Standard timing ID # 7	01	00000001
51	33	Standard timing ID # 7	01	00000001
52	34	Standard timing ID # 8	01	00000001
53	35	Standard timing ID # 8	01	00000001
54	36	Detailed timing description # 1 Pixel clock ("114.87MHz", According to VESA CVT Rev1.1)	DF	11011111
55	37	# 1 Pixel clock (hex LSB first)	2C	00101100
56	38	# 1 H active ("1600")	40	01000000
57	39	# 1 H blank ("388")	84	10000100
58	3A	# 1 H active : H blank ("1600 : 388")	61	01100001
59	3B	# 1 V active ("900")	84	10000100
60	3C	# 1 V blank ("63")	3F	00111111
61	3D	# 1 V active : V blank ("900 : 63")	30	00110000
62	3E	# 1 H sync offset ("116")	74	01110100
63	3F	# 1 H sync pulse width ("78")	4E	01001110
64	40	# 1 V sync offset : V sync pulse width ("7 : 12")	7C	01111100
65	41	# 1 H sync offset : H sync pulse width : V sync offset : V sync width ("116: 78 : 7 : 12")	00	00000000
66	42	# 1 H image size ("344 mm")	58	01011000
67	43	# 1 V image size ("193 mm")	C1	11000001
68	44	# 1 H image size : V image size ("344 : 193")	10	00010000
69	45	# 1 H boarder ("0")	00	00000000
70	46	# 1 V boarder ("0")	00	00000000
71	47	# 1 Non-interlaced ; Normal display, no stereo ; Digital Separate ; V sync POL is negative ; H sync POL is positive	1A	00011010
72	48	Detailed timing description # 1 Pixel clock ("64.5MHz", According to VESA CVT Rev1.1)	32	00110010
73	49	# 1 Pixel clock (hex LSB first)	19	00011001
74	4A	# 1 H active ("1600")	40	01000000
75	4B	# 1 H blank ("160")	A0	10100000
76	4C	# 1 H active : H blank ("1600 : 160")	60	01100000
77	4D	# 1 V active ("900")	84	10000100
78	4E	# 1 V blank ("17")	11	00010001
79	4F	# 1 V active : V blank ("900 : 17")	30	00110000
80	50	# 1 H sync offset ("48")	30	00110000
81	51	# 1 H sync pulse width ("32")	20	00100000
82	52	# 1 V sync offset : V sync pulse width ("3 : 5")	35	00110101



83	53	# 1 H sync offset : H sync pulse width : V sync offset : V sync width ("48: 32 : 3 : 5")	00	00000000
84	54	# 1 H image size ("344 mm")	58	01011000
85	55	# 1 V image size ("193 mm")	C1	11000001
86	56	# 1 H image size : V image size ("344 : 193")	10	00010000
87	57	# 1 H boarder ("0")	00	00000000
88	58	# 1 V boarder ("0")	00	00000000
89	59	# 1 Non-interlaced ; Normal display, no stereo ; Digital Separate ; V sync POL is negative ; H sync POL is positive	1A	00011010
90	5A	Detailed timing description # 3	00	00000000
91	5B	# 3 Flag	00	00000000
92	5C	# 3 Reserved	00	00000000
93	5D	# 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)	FE	11111110
94	5E	# 3 Flag	00	00000000
95	5F	# Dell P/N " F784K" 1st character ("F")	46	01000110
96	60	# Dell P/N " F784K" 2st character ("7")	37	00110111
97	61	# Dell P/N " F784K" 3st character ("8")	38	00111000
98	62	# Dell P/N " F784K" 4st character ("4")	34	00110100
99	63	# Dell P/N " F784K" 5st character ("K")	4B	01001011
100	64	LCD Supplier EEDID Revision #: "0"	80	10000000
101	65	Manufacturer P/N ("N")	4E	01001110
102	66	Manufacturer P/N ("1")	31	00110001
103	67	Manufacturer P/N ("5")	35	00110101
104	68	Manufacturer P/N ("6")	36	00110110
105	69	Manufacturer P/N ("O")	4F	01001111
106	6A	Manufacturer P/N ("6")	36	00110110
107	6B	Manufacturer P/N (If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010
108	6C	Flag	00	00000000
109	6D	Flag	00	00000000
110	6E	Flag	00	00000000
111	6F	Data Type Tag:	00	00000000
112	70	Flag	00	00000000
113	71	SMBUS value @ 10nits = 00	00	00000000
114	72	SMBUS value @ 17nits = 00	00	00000000
115	73	SMBUS value @ 24nits = 00	00	00000000
116	74	SMBUS value @ 30nits = 00	00	00000000
117	75	SMBUS value @ 60nits = 00	00	00000000
118	76	SMBUS value @ 110nits = 00	00	00000000
119	77	SMBUS value @ 150nits = 00	00	00000000
120	78	SMBUS value @ max nits = 00	00	00000000
121	79	Bit[1:0] 00:reserved , 01: single LVDS, 10: dual LVDS, 11: reserved Bit[2] 0: No RTC support , 1: RTC support Bit[7:3] Reserved	02	00000010
122	7A	BIST Enable: Yes = '01' No = '00' ("Yes")	01	00000001
123	7B	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	0A	00001010
124	7C	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000

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125	7D	(If <13 char, then terminate with ASCII code 0Ah, set remaining char = 20h)	20	00100000
126	7E	Extension flag	00	00000000
127	7F	Checksum	C1	11000001

6. CONVERTER SPECIFICATION

6.1 ABSOLUTE MAXIMUM RATINGS

Symbol	Ratings
V _{in}	40.0V
Gnd	+/-0.3V
PWM, EN	-0.3V~6.0V

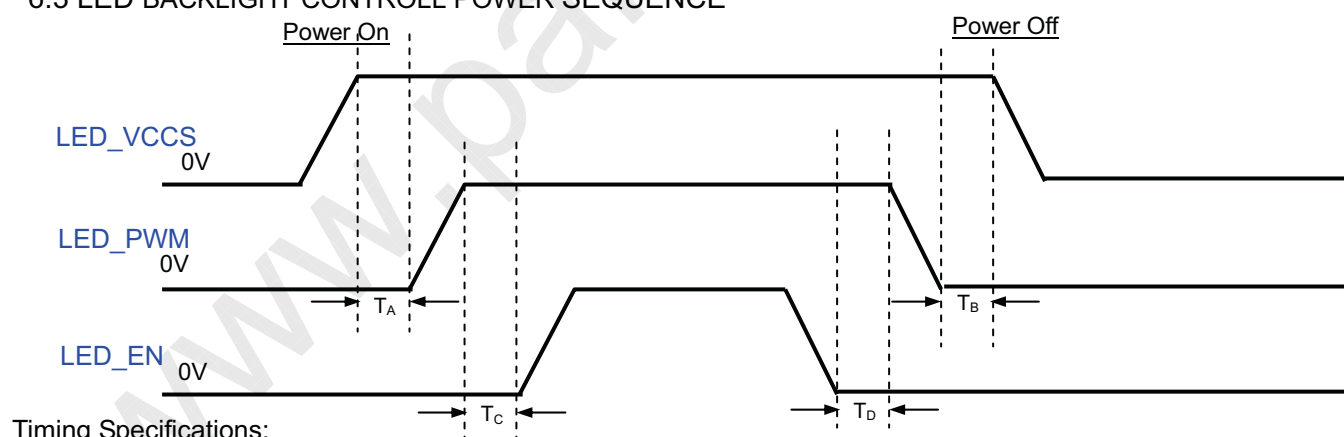
6.2 RECOMMENDED OPERATING RATINGS

Parameter		Symbol	Value			Unit	Note
			Min.	Typ.	Max.		
Converter Input power supply voltage		V _{in}	6	12.0	21.0	V	
EN Control Level	Backlight on		1.6	---	5.5	V	
	Backlight off		0	---	0.8	V	
PWM Control Level	PWM High Level		1.3	---	5.5	V	
	PWM Low Level		0	---	0.15	V	
PWM Control Duty Ratio			20		100	%	
PWM Control Frequency		f _{PWM}	190	210	230	Hz	
Converter Input Current	V _{in} =6V	I _{BL}	670	745	820	mA	(1)
	V _{in} =21V		180	200	220	mA	(2)

Note (1) The specified LED power supply current is under the conditions at V_{in} = 6V, T_a = 25 ± 2 °C, f_{PWM} = 200 Hz, Duty=100%.

Note (2) The specified LED power supply current is under the conditions at V_{in} = 21V, T_a = 25 ± 2 °C, f_{PWM} = 200 Hz, Duty=100%.

6.3 LED BACKLIGHT CONTROL POWER SEQUENCE



$$T_A \geq (0\text{ms})$$

$$T_B \geq (0\text{ms})$$

$$T_C \geq (10\text{ms})$$

$$T_D \geq (0\text{ms})$$

Note (1) Please follow the LED backlight power sequence as above. If the customer could not follow, it might cause backlight flash issue during display ON/OFF or damage the LED backlight controller

7.INTERFACE TIMING

7.1 INPUT SIGNAL TIMING SPECIFICATIONS

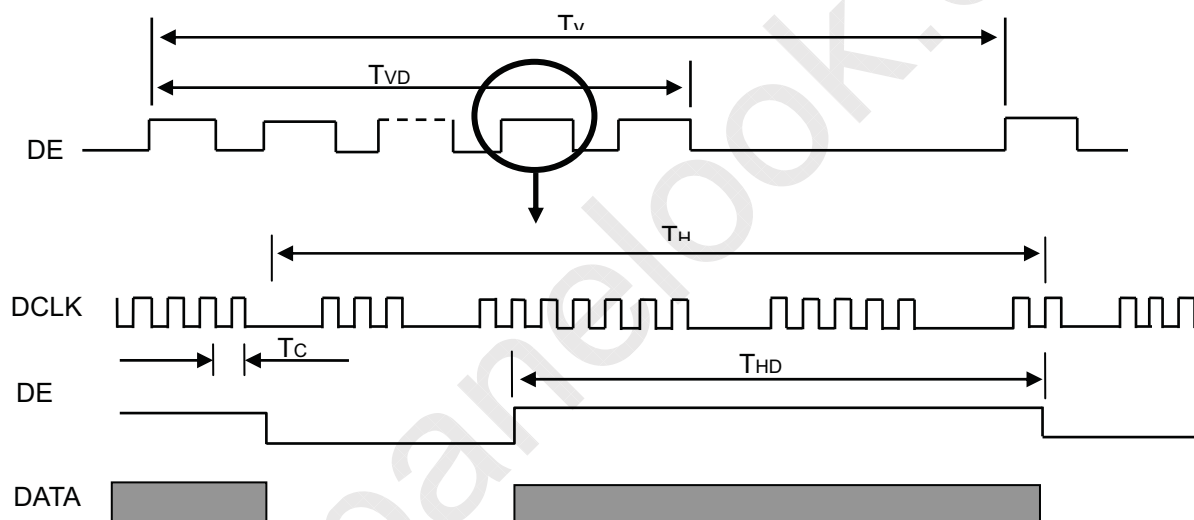
The input signal timing specifications are shown as the following table and timing diagram.

Signal	Item	Symbol	Min.	Typ.	Max.	Unit	Note
DCLK	Frequency	1/Tc	32.5	57.435	58	MHz	(2)
DE	Vertical Total Time	TV	910	963	1000	TH	-
	Vertical Active Display Period	TVD	900	900	900	TH	-
	Vertical Active Blanking Period	TVB	TV-TVD	63	TV-TVD	TH	
	Horizontal Total Time	TH	1700	1988	2000	Tc	(2)
	Horizontal Active Display Period	THD	1600	1600	1600	Tc	(2)
	Horizontal Active Blanking Period	THB	TH-THD	388	TH-THD	Tc	(2)

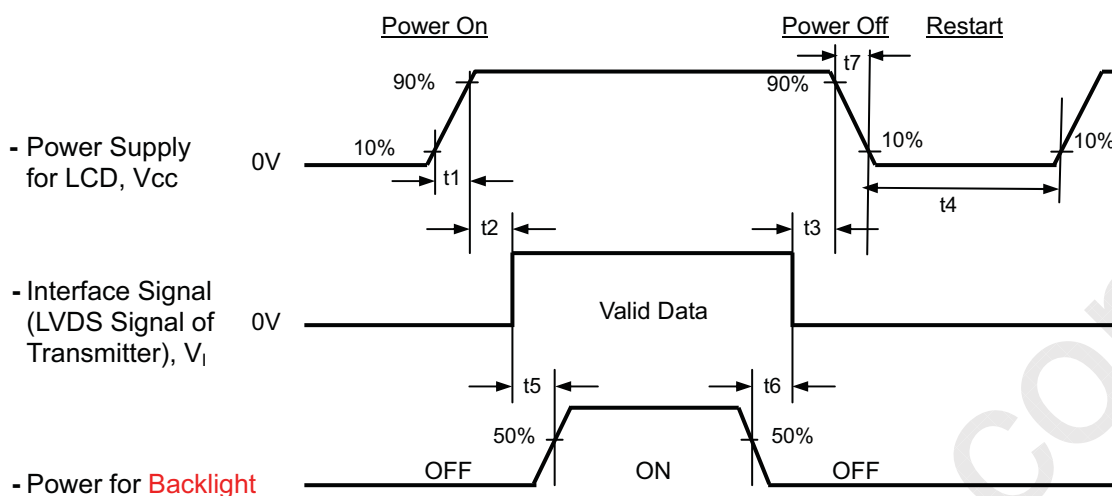
Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

(2) 2 channels LVDS input.

INPUT SIGNAL TIMING DIAGRAM



7.2 POWER ON/OFF SEQUENCE



Timing Specifications:

$$0.5 < t1 \leq 10 \text{ msec}$$

$$0 < t2 \leq 50 \text{ msec}$$

$$0 < t3 \leq 50 \text{ msec}$$

$$t4 \geq 500 \text{ msec}$$

$$t5 \geq 200 \text{ msec}$$

$$t6 \geq 200 \text{ msec}$$

Note (1) Please follow the power on/off sequence described above. Otherwise, the LCD module might be damaged.

Note (2) Please avoid floating state of interface signal at invalid period. When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight converter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight converter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time is better to follow $50\mu\text{s} \leq t7 \leq 11 \text{ ms}$.

8. OPTICAL CHARACTERISTICS

8.1 TEST CONDITIONS

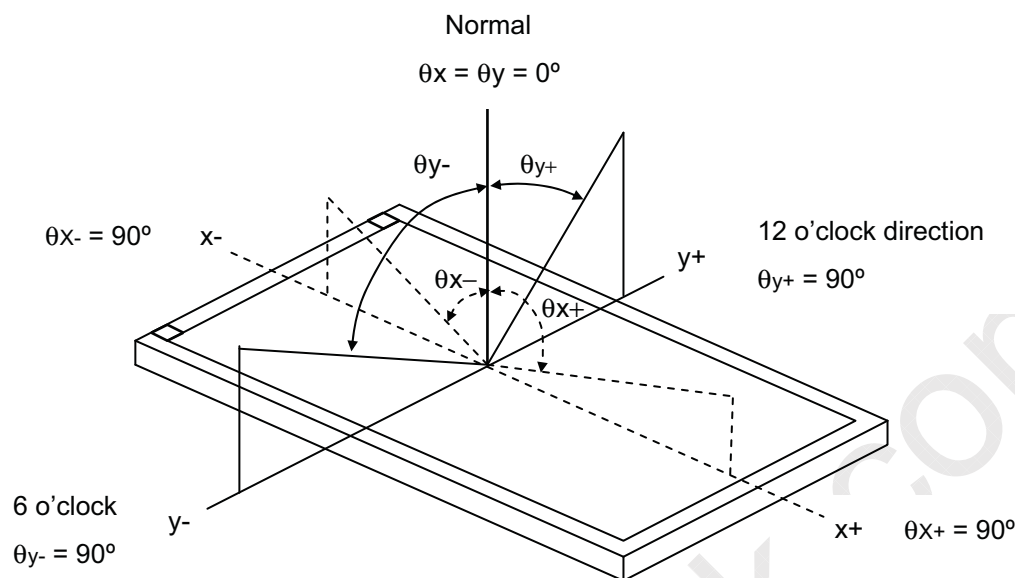
Item	Symbol	Value	Unit
Ambient Temperature	Ta	25±2	°C
Ambient Humidity	Ha	50±10	%RH
Supply Voltage	V _{CC}	3.3	V
Input Signal	According to typical value in "3. ELECTRICAL CHARACTERISTICS"		
LED Light Bar Input Current	I _L	120	mA

The measurement methods of optical characteristics are shown in Section 8.2. The following items should be measured under the test conditions described in Section 8.1 and stable environment shown in Note (5).

8.2 OPTICAL SPECIFICATIONS

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio		CR	$\theta_x=0^\circ, \theta_Y=0^\circ$ Viewing Normal Angle	500	650	-	-	(2), (5)
Response Time		T _R		-	3	8	ms	(3)
		T _F		-	7	12	ms	
Average Luminance of White		L _{Ave}		230	250	-	cd/m ²	(4), (5)
White Variation		ΔW5p				20-	%	(5),(6)
		ΔW13p				35	%	
Color Gamut		C.G		55	60		%	(6),(7)
Color Chromaticity	Red	R _x		TYP. -0.03	0.623 0.341 0.315 0.600 0.159 0.087 0.313 0.329	TYP. +0.03	-	(1)
		R _y					-	
	Green	G _x					-	
		G _y	-					
	Blue	B _x	-					
		B _y	-					
	White	W _x	-					
		W _y	-					
Viewing Angle	Horizontal	θ _x +	CR≥10	60	70	-	Deg.	(1),(5)
		θ _x -		60	70	-		
	Vertical	θ _y +		50	60	-		
		θ _y -		50	60	-		

Note (1) Definition of Viewing Angle (θ_x , θ_y):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

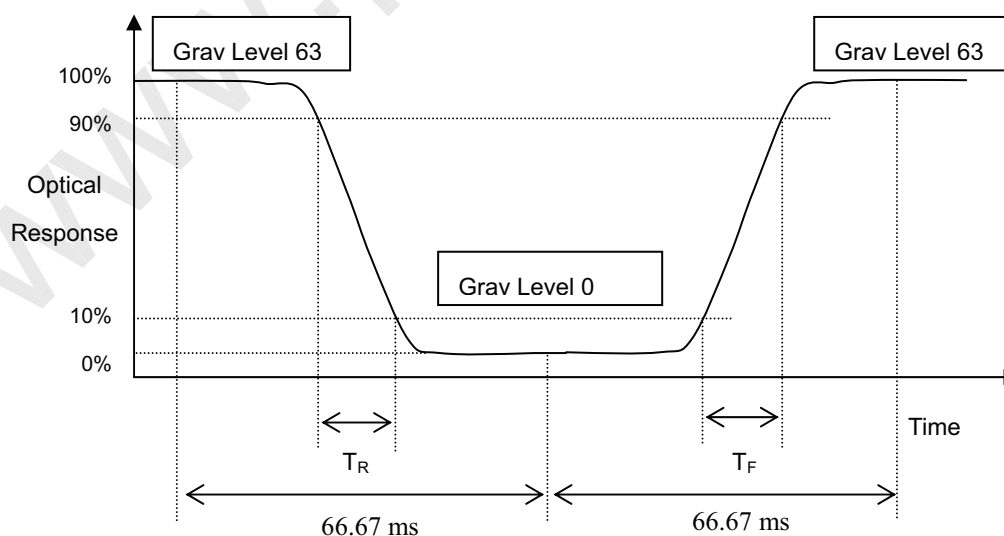
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$CR = CR(1)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time (T_R , T_F):



Note (4) Definition of Average Luminance of White (L_{AVE}):

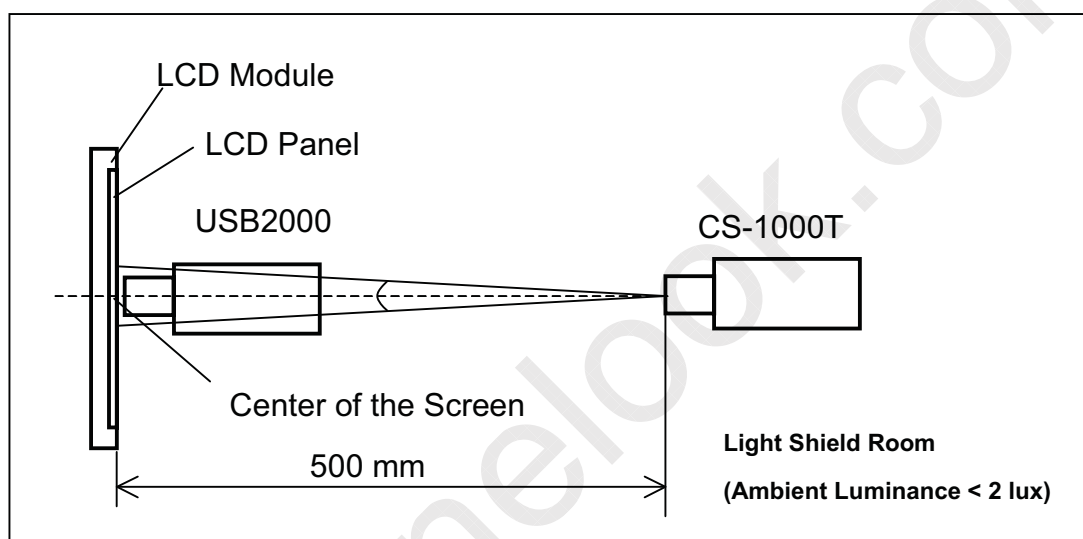
Measure the luminance of gray level 63 at 5 points

$$L_{AVE} = [L(33) + L(37) + L(55) + L(73) + L(77)] / 5$$

L(x) is corresponding to the luminance of the point X at Figure in Note (6)

Note (5) Measurement Setup:

The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.





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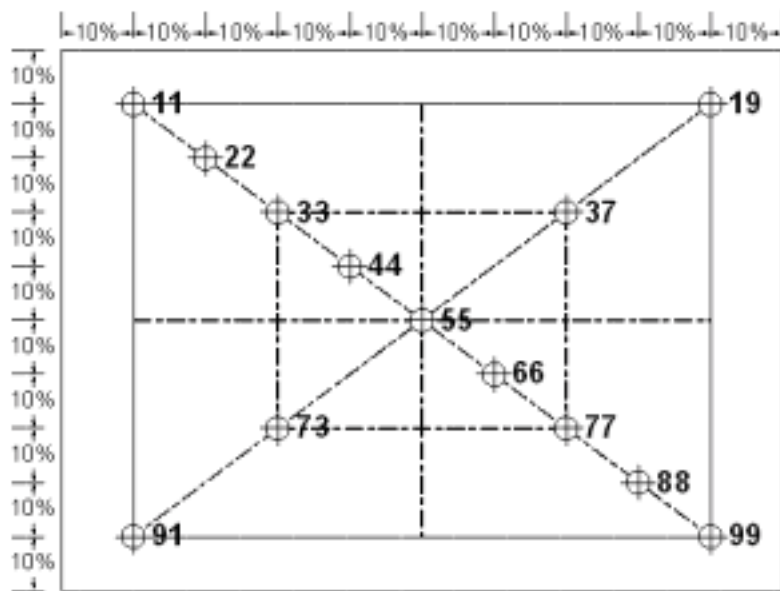
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Note (6) Definition of White Variation (δW_{5p} , δW_{13p}):

Measure the luminance of gray level 63 at 5, 13 points

$$\delta W_{5p} = \{1 - \{ \text{Minimum } [L(33) + L(37) + L(55) + L(73) + L(77)] / \text{Maximum } [L(33) + L(37) + L(55) + L(73) + L(77)] \} \} * 100\%$$

$$\delta W_{13p} = \{1 - \{ \text{Minimum } [L(11) \sim L(99)] / \text{Maximum } [L(11) \sim L(99)] \} \} * 100\%$$



Note (7) Definition of color gamut (C.G):

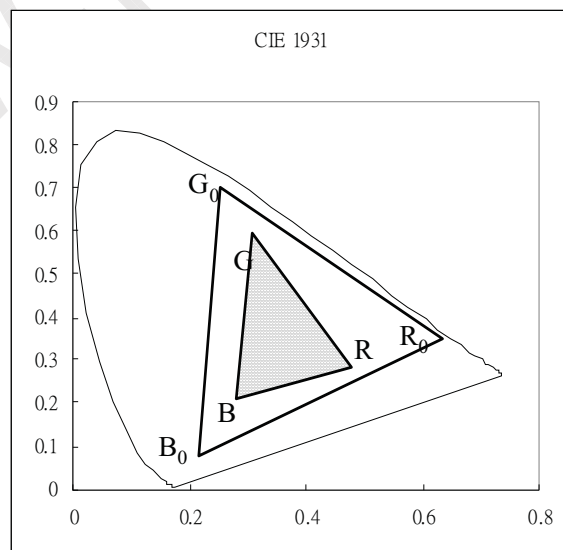
$$C.G = \Delta R G B / \Delta R_0 G_0 B_0 * 100\%$$

R_0, G_0, B_0 : color coordinates of red, green, and blue defined by NTSC, respectively.

R, G, B : color coordinates of module on 63 gray levels of red, green, and blue, respectively.

$\Delta R_0 G_0 B_0$: area of triangle defined by R_0, G_0, B_0

$\Delta R G B$: area of triangle defined by R, G, B



9. PRECAUTIONS

9.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the lamp wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

9.2 STORAGE PRECAUTIONS

- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of lamp will be higher than the room temperature.

9.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

10. PACKING

10.1 CARTON

Box Dimensions : 489(L)*382(W)*320(H)
Weight: Approx. 14.1kg(20 module .per. 1 box)

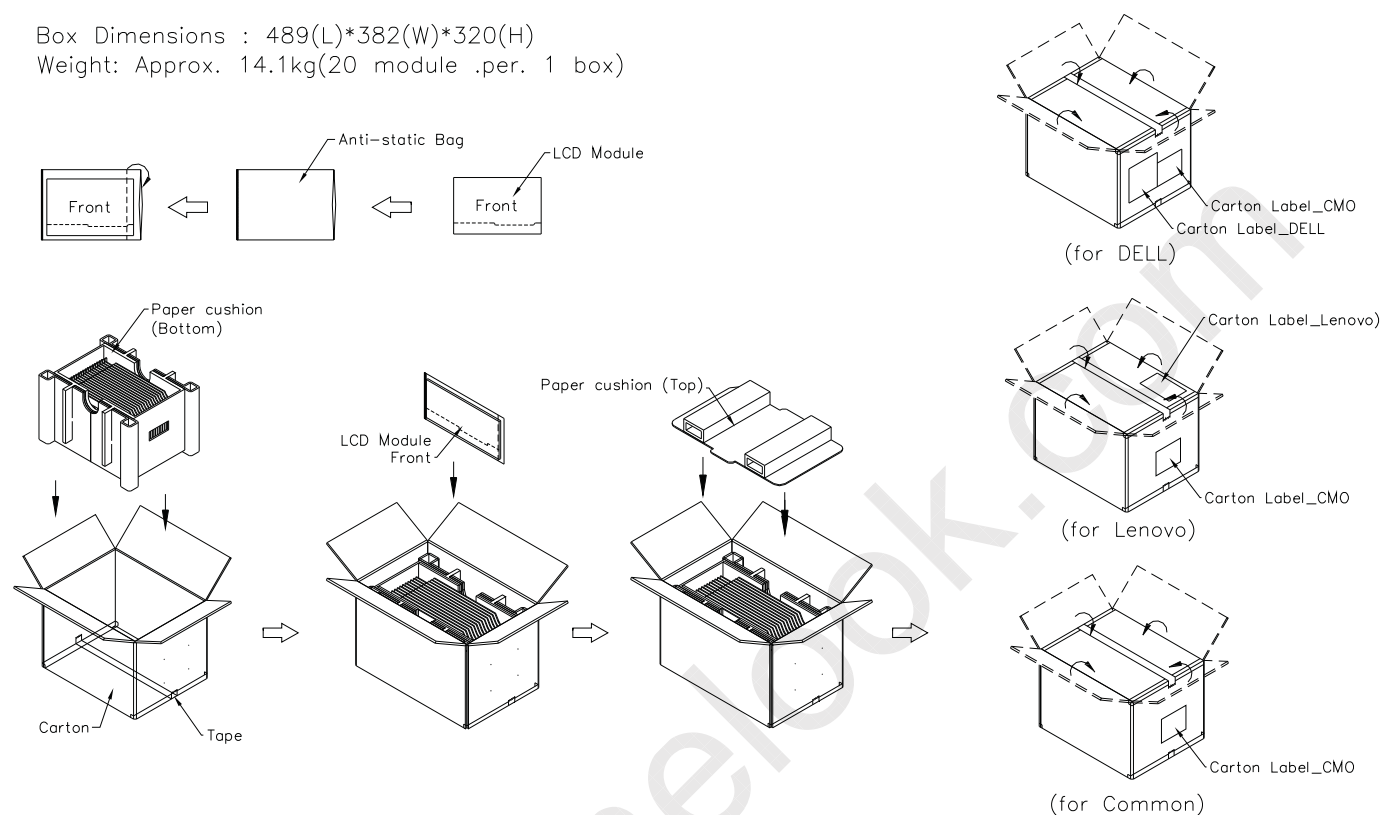


Figure. 10-1 Packing method

10.2 PALLET

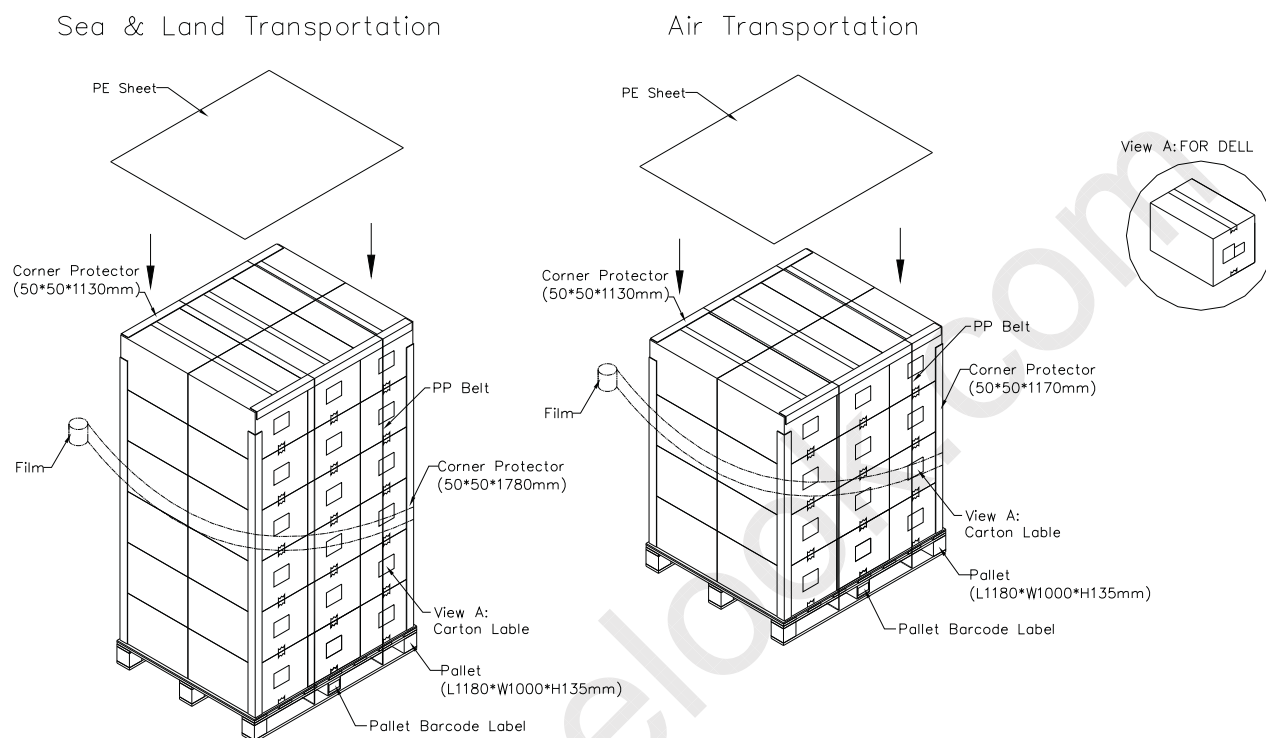
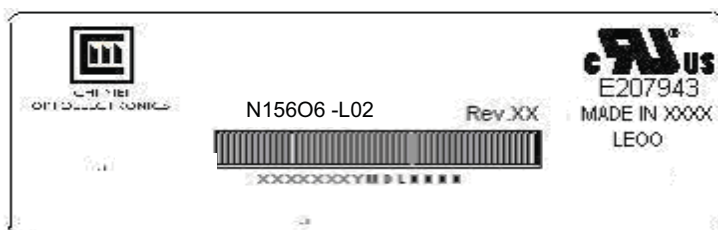


Figure. 10-2 Packing method

11.EFINITION OF LABELS

11.1 CMO MODULE LABEL

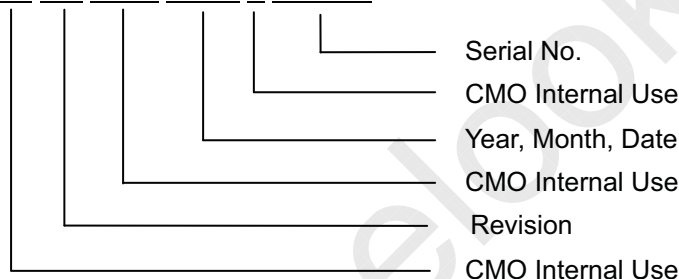
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N156O6 - L02

(b) Revision: Rev. XX, for example: A1, ..., C1, C2 ...etc.

(c) Serial ID: XX XX XX X Y M D X N N N N



(d) Production Location: MADE IN XXXX. XXXX stands for production location.

(e) UL/CB logo: "LEOO" especially stands for panel manufactured by CMO Ningbo satisfying UL/CB requirement. "LEOO" is the CMO's UL factory code for Ningbo factory.

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1st to 31st, exclude I, O and U

(b) Revision Code: cover all the change

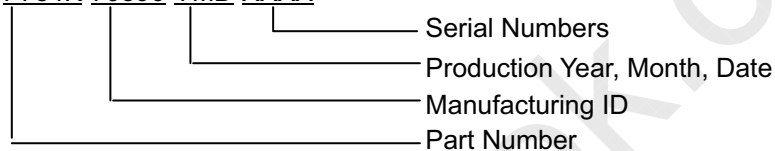
(c) Serial No.: Manufacturing sequence of product

11.2 DELL 2D MODULE LABEL

Dell 2D label contains information as below:



(a) Serial ID: TW-0F784K-70896-YMD-XXXX



(b) Production location: Made in XXXX.

(c) Revision code: A00..etc.

11.3 CMO CARTON LABEL

CMO carton label is as below:



(a) Production location: Made In XXXX. XXXX stands for production location.

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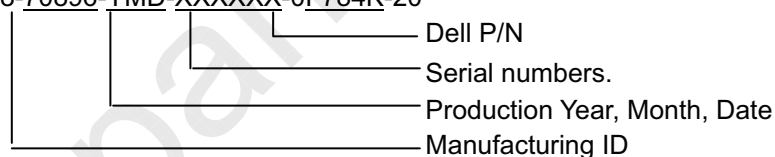
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11.4 DELL CARTON LABEL

Dell carton label contains information as below:



(a) PKG ID: 04688-70896-YMD-XXXXXX-0F784K-20



(b) Production location: Made in China

(c) Revision code: A00..etc.

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